Standardized Flight Recorder Documentation

**Ian Smith* ***Howard Posluns*

**Software Kinetics Ltd, 65 Iber Road, Stittsville, Ontario, Canada K2S 1E7*
Tel: (613) 831-0888, Email: Ian.Smith@SoftwareKinetics.ca
***Transport Canada, Transportation Development Centre, 800 René Lévesque Blvd W., Suite 600, Montreal, Quebec, Canada H3B 1X9*
Tel: (514) 283-0034, Email: poslunh@tc.gc.ca

KEYWORDS
Aviation
Flight Data Recorder (FDR)
Flight Recorder Configuration Standard (FRCS)
Accident Investigation

INTRODUCTION
The need for an international standard to document the format and arrangement of flight data recorded by Flight Data Recorder Systems (FDRS) has long been recognized by air safety investigators responsible for the retrieval and analysis of FDR data following an occurrence. Significant time delays can be eliminated where complete and accurate information about the Flight Data Recorder System is readily available to investigative authorities.

THE NEED FOR A STANDARD
With the introduction of modern aircraft and recording devices, the quantity of recorded flight parameters available on the FDR and other recording devices continues to increase. With this increase in available information comes a corresponding increase in the demands for documentation to describe the data recorded by FDRS. Currently, FDRS documentation available to air safety investigators may vary in both format and content and is typically supplied as a paper document.

Investigators are faced with the time consuming task of finding and then extracting the necessary information from the supplied documentation (i.e., all of the information required to convert raw recorded data into time-stamped engineering units). This information then needs to be transcribed into an electronic format suitable for the particular FDR replay and analysis system used by the investigative agency. When a large number of flight parameters are recorded, the manual transcription process may be both time consuming and error prone.

This process of extracting and transcribing FDRS configuration information can affect both the timeliness and accuracy of the recovery of data after an occurrence. This in turn affects the timeliness and effectiveness of recommended safety improvements. Standardized format and content for documenting the data recorded by FDRS, as well as, a standardized electronic format for the exchange of such information is necessary.

Figure 1 illustrates the process involved in recovering recorded flight data.

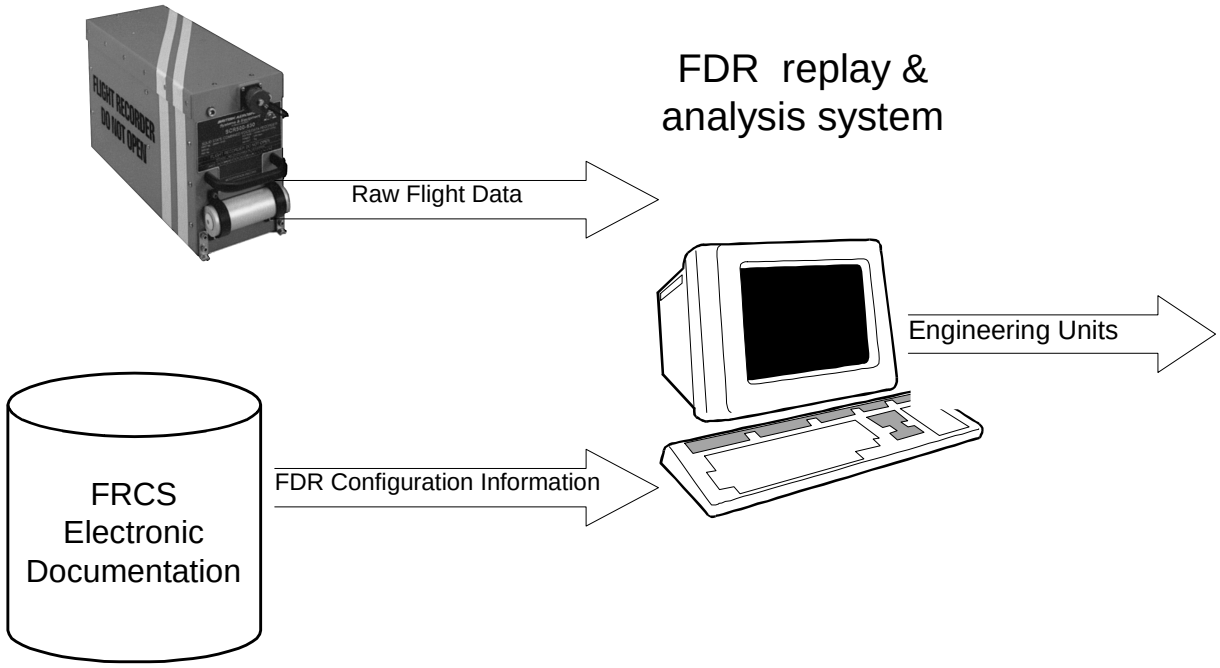

Figure 1: Recovery of flight data

EFFORT TO DEFINE A STANDARD

Over the past two years, Transport Canada's Transportation Development Centre has sponsored a project to define a Flight Recorder Configuration Standard (FRCS). This work has been performed with the participation and input of an international Project Review Committee with both government and industry representation.

The effort has focused on documenting and defining those FDRS documentation items that are required specifically by investigators for the recovery and analysis of FDR data. Items in the standard are defined as either mandatory or optional. While the investigators desire as much information as possible, it was recognized that some information may not be readily available to those responsible for maintaining the documentation. The mandatory items represent the minimum set of information required by the investigators.

The second aspect of the effort was to define a portable electronic format that is suitable for the exchange of the flight recorder configuration information. Existing electronic formats tend to be tied to particular manufacturers ground replay stations. These formats are subject to frequent change with the evolution of the products. The FRCS does not seek to replace these existing formats, rather the desire is to have a common format, which can be "exported" from and "imported" into the wide variety of products in use today. Eventually, it is hoped that all manufacturers will adopt the FRCS.

During the project, a preliminary version of the standard was developed along with a sample software application that makes use of the standard for demonstration purposes. The sample application is illustrated in Figure 2. This material was distributed for international review and has been tested in a Field Trial. The standard was revised based on the comments received and acceptance is being sought from various industry, government, and international organizations such as ICAO, ISASI and EuroCAE.

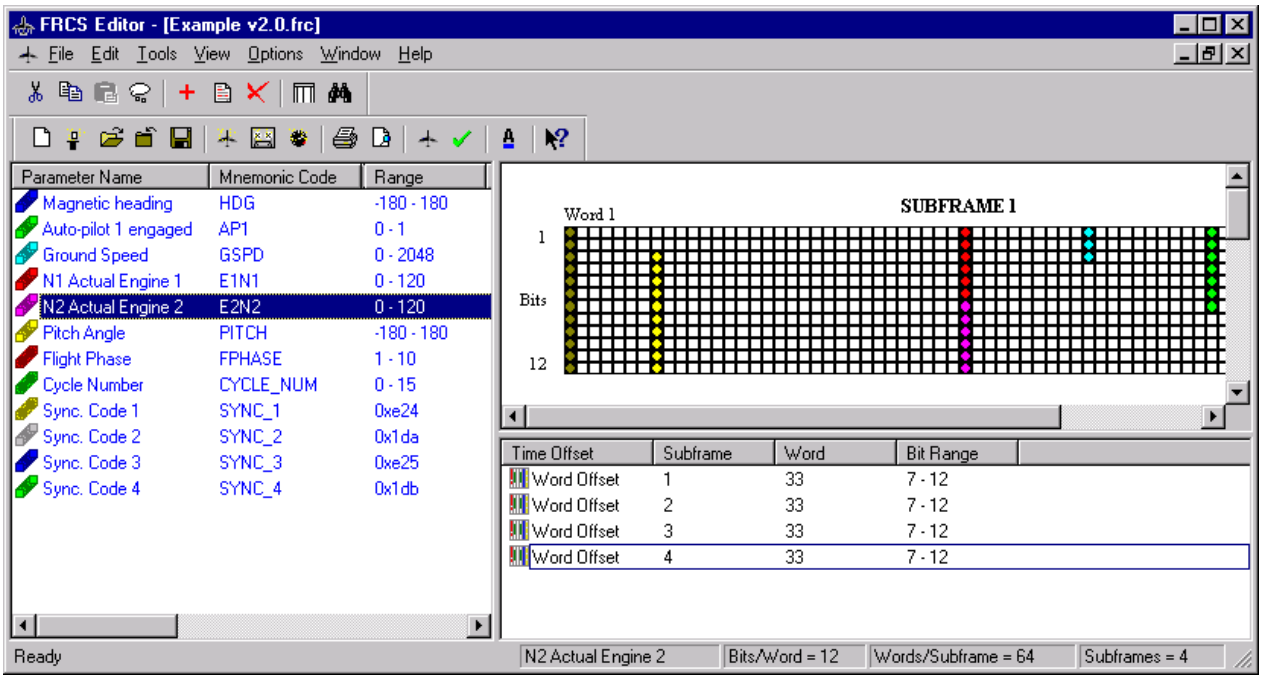

Figure 2: Sample Application Using FRCS

FLIGHT RECORDER CONFIGURATION STANDARD

The FRCS content is grouped into header, record (subframe) and parameter information. Furthermore, the standard has been defined to accommodate differences in formats for the different manufacturers and aircraft configurations [1] [2].

CONTENT
The header contains information specific to the aircraft, on-board data acquisition and recording equipment and record (subframe) definition. The record (subframe) information consists of word length, record (subframe) size and duration.

The information associated with each parameter includes:

- Identification items

  These include name, mnemonic, identifiers, user-definable fields, date, time and comments.

- Location items

  These contain details referring to the sample and component locations in the frame.

- Conversion items

  Equations and tables for converting the raw data to engineering units and the accuracy of the mathematical conversion are documented.

- Accuracy items

  Some examples are valid operational range, accuracy, resolution and transport delays.

- Sensor and signal items

  These include the sensor type, signal type and signal source.

- Digital Information Transfer System (DITS) items

  These items refer to the label, bits numbers and coding.

DESIGN CONSIDERATIONS

The standard is defined to be as flexible as possible to accommodate non-standard and future recording formats. For example, the number of bits per FDR word is not assumed to be 12 even though this is the most common size. A second example is the ability to accommodate the documentation of recording formats using variable length records (subframes) as currently used in some military flight recording applications.

To ensure maximum portability of the electronic files, the standard specifies an ASCII format rather than a less portable binary format. The layout of the electronic file is defined by a "grammar" which can be parsed using common software tools. The approach of using a grammar to define the layout was chosen to reduce the likelihood of ambiguity in the interpretation of the format. The information for an aircraft configuration is contained in a single electronic file. The use of a single file simplifies the electronic transfer of the information.

In response to international comments and to enhance the usefulness of the standard for non-investigative agencies such as operators and manufacturers, the standard allows individual users to add their own specific fields and data values. For example, a manufacturer may wish to define a field "DFDAU Input Port" for their own use. While the FRCS does not require this field, the standard is flexible enough to allow additional information to be saved with the file. This flexibility can provide benefits to Flight Data Monitoring (FDM) and Flight Operational Quality Assurance (FOQA) programs.

CONCLUSIONS

The maintenance of flight recorder configuration information in a common, standard electronic format should facilitate and expedite deciphering recorded flight data.

Adoption of the FRCS by industry is a key step to achieving international acceptance. A mechanism must exist to promote the use of the standard and to ensure FDRS documentation is adequately maintained throughout the life cycle of an aircraft and a means must be in place to make the information available to investigation authorities when required. Endorsement of the FRCS by industry, government authorities, and international bodies would be instrumental in achieving international acceptance.

The FRCS is currently endorsed by the FAA and Transport Canada as an acceptable means of documenting data recorded by FDRS [3] [4].

ACKNOWLEDGEMENTS

Software Kinetics gratefully acknowledges the contribution of the following member organizations of the Project Review Committee: Bombardier / Canadair, National Transportation Safety Board,

Transportation Safety Board of Canada, Transport Canada - Aviation, Transport Canada -Transportation Development Centre, Federal Aviation Administration, and the National Research Council of Canada.

The authors wish to acknowledge Transport Canada's Transportation Development Centre (TDC) and Natural Resources Canada's Program of Energy R&D (PERD) for their support of the FRCS project.

REFERENCES

1. Transport Canada, *TP 13140E Flight Recorder Configuration Standard Version 1.0*, January 1999.
2. Software Kinetics Ltd., FRCS web site, http://frcs.sofkin.ca
3. Federal Aviation Administration, *DRAFT Advisory Circular 20-DFDRS-1*, December 3, 1998.
4. Transport Canada Aviation, *Airworthiness Manual Advisory (AMA) 551.100*, December 1, 1998.

BIOGRAPHIES

Mr. Ian Smith manages the Advanced Systems group at Software Kinetics. He is currently the project manager for the Flight Recorder Configuration Standard project. Over the last 11 years, he has been involved in a number of flight data recorder, avionics, and air traffic control related projects. Mr. Smith holds a B.Sc. from the University of Guelph as well as an M.Sc. in Computer Science from Queen's University.

Mr. Howard Posluns is the Acting Chief, Advanced Technology, of Transport Canada's Transportation Development Centre (TDC). TDC, established in Montreal in 1970, is Transport Canada's multi-modal R&D arm. For the past 15 years Mr. Posluns has been involved in the management of various R&D projects related to aviation safety efficiency, and security. Mr. Posluns holds an electrical engineering degree from Concordia University, and is a member of the Institute of Electrical and Electronic Engineers (IEEE).